1	01:00:45:20	01:00:49:00	MAN: How is the data distributed for the different years?
2	01:00:49:02	01:00:51:22	I want them to experience statistics
3	01:00:51:24	01:00:53:25	as a problem-solving process.
4	01:00:53:27	01:00:57:11	WOMAN: Statistics is detective work.
5	01:00:57:13	01:01:00:20	Will exercising make you live longer?
6	01:01:00:22	01:01:02:22	Are hormones good or bad for your heart?
7	01:01:03:24	01:01:04:26	170.
8	01:01:04:28	01:01:06:11	MAN: Why aren't people, through time
9	01:01:06:13	01:01:07:27	getting taller?
10	01:01:07:29	01:01:10:10	What are the socioeconomic causes?
11	01:01:12:18	01:01:15:13	Statistics is a process, a vision of learning.
12	01:01:20:02	01:01:22:02	Think about the question "What is statistics?"
13	01:01:22:04	01:01:24:03	And what I'd like to begin with today
14	01:01:24:05	01:01:26:14	is just to have you get together in groups
15	01:01:26:16	01:01:29:02	and share your different ideas with each other.
16	01:01:29:04	01:01:31:13	MAN: ...would be a representation of the data?
17	01:01:31:15	01:01:34:22	NARRATOR: A group of 17 K-through-8 teachers gathers
18	01:01:34:24	01:01:38:20	for a workshop on data analysis, statistics and probability.
19	01:01:38:22	01:01:40:20	WOMAN: And the next one.
20	01:01:40:22	01:01:43:22	We have all the different categories that would go here.
21	01:01:43:24	01:01:45:17	We have "Limiting the Sampling..."
22	01:01:45:19	01:01:46:29	NARRATOR: The facilitator
23	01:01:47:01	01:01:49:29	Professor Gary Kader of Appalachian State University
24	01:01:50:01	01:01:53:16	begins with the question "What is statistics?"
25	01:01:53:18	01:01:56:06	KADER: Let's just pick on the blue group for a minute.
26	01:01:56:08	01:01:58:17	The blue group says: "We gather data.
27	01:01:58:19	01:02:01:08	"Organizing data, analyzing data
28	01:02:01:10	01:02:03:25	presenting/explaining..."
29	01:02:03:27	01:02:04:28	What?

30 01:02:05:00 01:02:06:05 What was your thought here?
31 01:02:06:07 01:02:07:12 "Presenting/explaining..."
32 01:02:07:14 01:02:08:15 The data.
33 01:02:08:17 01:02:09:27 KADER:
The data. See?
34 01:02:09:29 01:02:11:23 Drawing conclusions from...?
35 01:02:11:25 01:02:12:24 CLASS:
The data.
36 01:02:12:26 01:02:13:24 The data.
37 01:02:13:26 01:02:15:09 KADER:
In today's session
38 01:02:15:11 01:02:18:05 the key concept to develop
for the teachers is...
39 01:02:18:07 01:02:22:18 is the notion that statistics *is*
this problem-solving process.
40 01:02:22:20 01:02:24:21 KADER:
This one, I think,
is very interesting.
41 01:02:24:23 01:02:26:06 I'd... I'd like the green group
42 01:02:26:08 01:02:28:25 to elaborate somewhat
on what they're doing there.
43 01:02:28:27 01:02:31:06 That's a very fascinating way
44 01:02:31:08 01:02:33:16 of presenting what's going on
in statistics.
45 01:02:33:18 01:02:35:03 MAN:
Our little web--
46 01:02:35:05 01:02:37:16 we're all set to turn
that right into
a written report.
47 01:02:37:18 01:02:38:28 (*laughing*):
Are you?
48 01:02:39:00 01:02:40:13 MAN:
We're ready.
49 01:02:40:15 01:02:43:04 We broke it down
into two parts:
your plan and design
50 01:02:43:06 01:02:45:10 and then into your
collecting of your data.
51 01:02:45:12 01:02:48:17 Uh-huh, yes, "collecting data"
appears in almost all of them
52 01:02:48:19 01:02:52:19 as does the "organizing data,"
"representing the data"
53 01:02:52:21 01:02:58:00 which I think of, in some vein,
as... as organizing data.
54 01:02:58:02 01:02:59:14 "Analysis and..."
55 01:02:59:16 01:03:00:16 WOMAN:
"Inferences."
56 01:03:00:18 01:03:01:23 "Inferences."
57 01:03:01:25 01:03:03:14 KADER:
Hmm. What do you mean by that?
58 01:03:03:16 01:03:04:26 What do *I* mean
by the analy...?
59 01:03:04:28 01:03:06:06 KADER:
Uh-huh.
60 01:03:06:08 01:03:08:12 You need to take a look
at what your information...

61 01:03:08:14 01:03:10:08 and see if what you are actually collecting
62 01:03:10:10 01:03:13:00 is what you are actually looking for.
63 01:03:13:02 01:03:15:20 Uh-huh, okay.
64 01:03:15:22 01:03:17:04 And then finally "conclusions."
65 01:03:17:06 01:03:18:12 Very nice.
66 01:03:18:14 01:03:20:02 Very nice summary of what statistics...
67 01:03:20:04 01:03:21:06 All these are great ideas
68 01:03:21:08 01:03:22:25 and they're all related to statistics.
69 01:03:22:27 01:03:24:25 And I think it's better for you to sort of say
70 01:03:24:27 01:03:27:10 "Well, these are the things I think go on in statistics"
71 01:03:27:12 01:03:28:24 instead of me just getting up here
72 01:03:28:26 01:03:30:15 and giving you a list of those things.
73 01:03:30:17 01:03:32:28 We may add some things to this list as we go on
74 01:03:33:00 01:03:35:12 but I think this is a real good starting point
75 01:03:35:14 01:03:37:10 for what we want to do in this class.
76 01:03:37:12 01:03:41:24 NARRATOR: Next, the teachers conduct a statistical investigation.
77 01:03:41:26 01:03:45:07 I'd like you to think about this problem or this question:
78 01:03:45:09 01:03:48:15 What piece of information might you be interested in knowing
79 01:03:48:17 01:03:51:00 about the other folks in this room?
80 01:03:51:02 01:03:54:16 I'd then like you to collect the data.
81 01:03:54:18 01:03:56:05 Clearly, you're going to need data
82 01:03:56:07 01:03:58:19 if you're going to do a statistical investigation.
83 01:03:58:21 01:04:00:22 That's kind of the critical element.
84 01:04:00:24 01:04:04:03 A lot of you have mentioned representing the data
85 01:04:04:05 01:04:07:19 with graphs and tallies and those sorts of things
86 01:04:07:21 01:04:10:11 organizing the data, analyzing the data
87 01:04:10:13 01:04:13:07 presenting the data, okay?
88 01:04:13:09 01:04:16:14 I think statistics is best learned by doing statistics.
89 01:04:16:16 01:04:18:12 It's where you have little...
90 01:04:18:14 01:04:20:28 KADER: You learn how to do things

			when you do them.
91	01:04:21:00	01:04:26:15	You come to better understand things by doing.
92	01:04:26:17	01:04:28:04	NARRATOR: Professor Kader suggests
93	01:04:28:06	01:04:30:03	that the teachers begin the investigation
94	01:04:30:05	01:04:32:10	by asking a question and then collecting data.
95	01:04:32:12	01:04:33:16	WOMAN: We'd like to know
96	01:04:33:18	01:04:35:01	how many years you've been teaching
97	01:04:35:03	01:04:37:11	and in how many school systems you've been teaching.
98	01:04:37:13	01:04:40:05	Okay, we could do that.
99	01:04:40:07	01:04:42:03	Most of them did not think about the idea
100	01:04:42:05	01:04:44:14	that when you do statistics, you have to first ask
101	01:04:44:16	01:04:46:22	a question that you can answer with statistics.
102	01:04:46:24	01:04:49:00	I've been teaching nine years...
103	01:04:49:02	01:04:49:23	Nine?
104	01:04:49:25	01:04:50:23	In one system.
105	01:04:50:25	01:04:51:17	One.
106	01:04:51:19	01:04:52:17	35 years, three.
107	01:04:52:19	01:04:54:20	Three.
108	01:04:54:22	01:04:55:24	WOMAN: 14, one system.
109	01:04:55:26	01:04:56:24	Fourteen.
110	01:04:56:26	01:04:58:01	35, one system.
111	01:04:58:03	01:04:59:06	God bless you.
112	01:04:59:08	01:05:01:11	Wonderful.
113	01:05:01:13	01:05:05:05	Okay, we're doing a survey on elementary schools
114	01:05:05:07	01:05:07:16	and what level you teach at.
115	01:05:07:18	01:05:09:05	We're also trying to decide
116	01:05:09:07	01:05:13:03	if the females are teaching more in the younger elementary grades
117	01:05:13:05	01:05:15:14	and the males are in the higher grades.
118	01:05:15:16	01:05:18:09	So, can you please tell us what grade level you teach?
119	01:05:18:11	01:05:20:10	I teach a first/second grade, it's multigrade.
120	01:05:20:12	01:05:22:11	Okay.
121	01:05:22:13	01:05:24:13	WOMAN: And I teach second grade.
122	01:05:24:15	01:05:27:00	WOMAN 2: Ten to 12, high school.

123 01:05:27:02 01:05:28:12 WOMAN 3:
In grade six.
124 01:05:28:14 01:05:31:05 NARRATOR:
Next, the teachers
graph the data
125 01:05:31:07 01:05:33:09 so they can analyze the results.
126 01:05:33:11 01:05:34:27 WOMAN:
What we're going to be doing
127 01:05:34:29 01:05:36:29 is we're going to be putting
our data in order
128 01:05:37:01 01:05:40:02 to look at what kind
of representation
129 01:05:40:04 01:05:42:11 would be the best way
to handle this information.
130 01:05:42:13 01:05:43:17 If we use a line plot
131 01:05:43:19 01:05:46:25 we're thinking of
the scale of the line plot
132 01:05:46:27 01:05:49:29 would have to go from...
this is the range
133 01:05:50:01 01:05:52:19 and it would have to go
from zero to 35.
134 01:05:52:21 01:05:55:16 And we could do one increments
but not label every one.
135 01:05:55:18 01:05:57:08 Would that
be okay?
136 01:05:57:10 01:05:58:29 BOTH:
Mm-hmm.
137 01:05:59:01 01:06:01:10 How much space do you want?
Because we've got...
138 01:06:01:12 01:06:02:10 Oh, yeah.
139 01:06:02:12 01:06:03:25 Maybe we can't...
let's decide.
140 01:06:03:27 01:06:05:23 We can make the bar...
six, two inches each.
141 01:06:05:25 01:06:06:26 Okay.
142 01:06:06:28 01:06:08:23 Let's see, how many bars
do you have?
143 01:06:08:25 01:06:09:26 Six, right?
144 01:06:09:28 01:06:10:26 Right.
145 01:06:10:28 01:06:11:26 Let's see.
146 01:06:11:28 01:06:12:26 Let's plan.
147 01:06:12:28 01:06:14:04 Let's see.
148 01:06:14:06 01:06:16:26 Six... six times two
is 12 inches...
149 01:06:16:28 01:06:18:08 Twelve.
150 01:06:18:10 01:06:21:03 And then we need to have...
let's leave one inch here.
151 01:06:21:05 01:06:23:05 One and one.
152 01:06:23:07 01:06:25:01 KADER:
The goal of the activity
153 01:06:25:03 01:06:28:07 is to get them active
and to get them to thinking
154 01:06:28:09 01:06:30:27 about doing statistics
in their classroom
155 01:06:30:29 01:06:32:28 in this activity-based format.
156 01:06:33:00 01:06:36:10 WOMAN:

If we use one,
it's going to be a long range.

157 01:06:36:12 01:06:38:28 We might want to use five...
one, five

158 01:06:39:00 01:06:42:15 instead of... because
you're going to have
from one to 35.

159 01:06:42:17 01:06:43:21 That's a big, big gap.

160 01:06:43:23 01:06:44:26 WOMAN:
Exactly.

161 01:06:44:28 01:06:46:18 So this is going to be
"Number of Years"

162 01:06:46:20 01:06:47:26 working outside of education.

163 01:06:47:28 01:06:49:02 Uh-huh, by intervals.

164 01:06:49:04 01:06:51:07 And we're going to have
"Number of years."

165 01:06:51:09 01:06:52:24 Mm-hmm.

166 01:06:52:26 01:06:54:06 Let's say "Zero to two."

167 01:06:54:08 01:06:55:23 Mm-hmm,
the different years.

168 01:06:55:25 01:06:56:23 "Three to five."

169 01:06:56:25 01:06:57:23 Mm-hmm.

170 01:06:57:25 01:06:58:23 "Six to eight."

171 01:06:58:25 01:06:59:20 Mm-hmm.

172 01:06:59:22 01:07:00:16 KADER:
Okay.

173 01:07:00:18 01:07:01:29 I think we've learned

174 01:07:02:01 01:07:04:05 some interesting things
about this group of people.

175 01:07:04:07 01:07:05:17 I've asked each group

176 01:07:05:19 01:07:07:18 to identify one...
at least one representative

177 01:07:07:20 01:07:10:09 to talk about what it is
they've learned about the group.

178 01:07:10:11 01:07:12:22 Come on up.

179 01:07:12:24 01:07:15:13 Well, one of the things
that we felt was difficult

180 01:07:15:15 01:07:17:13 was coming up
with the right question

181 01:07:17:15 01:07:20:12 and as you can see, the "Years
of teaching experience"

182 01:07:20:14 01:07:22:22 was a question
that everybody asked.

183 01:07:22:24 01:07:24:14 And we collected the data

184 01:07:24:16 01:07:27:01 and decided to show it
in a line plot.

185 01:07:27:03 01:07:28:08 One of the reasons

186 01:07:28:10 01:07:30:02 that we decided to show it
in a line plot

187 01:07:30:04 01:07:32:29 is we thought that
it might be more interesting

188 01:07:33:01 01:07:35:11 that the data might have skewed
in different directions

189 01:07:35:13 01:07:36:18 and we found that actually

190 01:07:36:20 01:07:38:11 it wasn't as interesting
as we thought.

191 01:07:38:13 01:07:41:28 Then we decided to see where
the people were teaching--
192 01:07:42:00 01:07:43:13 what grade level
were you teaching.
193 01:07:43:15 01:07:46:24 And we found that
to best represent that data
194 01:07:46:26 01:07:48:24 we made a frequency table.
195 01:07:48:26 01:07:52:15 And we have grade levels
one through high school.
196 01:07:52:17 01:07:54:11 What we did discover, though
197 01:07:54:13 01:07:57:06 was that you can teach data...
statistical analysis
198 01:07:57:08 01:08:01:10 in every grade level, so that
this is a good representation.
199 01:08:01:12 01:08:03:17 We do have a representation
of every grade
200 01:08:03:19 01:08:05:19 except for kindergarten
and grade four.
201 01:08:05:21 01:08:06:18 Very good.
202 01:08:06:20 01:08:07:26 (*class applauds*)
203 01:08:07:28 01:08:09:28 KADER:
Okay, thank you, group three.
204 01:08:10:00 01:08:11:13 And group four.
205 01:08:11:15 01:08:12:29 WOMAN:
All right.
206 01:08:13:01 01:08:15:02 For years of working
outside of education
207 01:08:15:04 01:08:16:21 we found that the majority of us
208 01:08:16:23 01:08:21:02 went into education
within at least two years
209 01:08:21:04 01:08:22:27 after leaving and
getting our degrees.
210 01:08:22:29 01:08:25:01 Actually there were
eight that were zero--
211 01:08:25:03 01:08:27:21 right... in other
words, no years of
any other occupation.
212 01:08:27:23 01:08:29:26 And then the rest,
from three to five years--
213 01:08:29:28 01:08:31:11 there were three people
214 01:08:31:13 01:08:33:27 who had worked for
three to five years
outside of education.
215 01:08:33:29 01:08:36:02 Two people worked
for six to eight years
216 01:08:36:04 01:08:37:17 outside of education.
217 01:08:37:19 01:08:40:23 And then there were
three who worked for
nine or more years
218 01:08:40:25 01:08:42:17 outside the field
of education.
219 01:08:42:19 01:08:44:18 But what we intended to show
didn't work out.
220 01:08:44:20 01:08:45:27 If you...
221 01:08:45:29 01:08:48:11 One thing we found that was
kind of interesting is

222 01:08:48:13 01:08:50:02 we thought that
most of the people
223 01:08:50:04 01:08:52:18 that fell in
the education category
224 01:08:52:20 01:08:56:08 who... their undergrad was
in some type of education...
225 01:08:56:10 01:08:58:19 would probably fall
on this chart
226 01:08:58:21 01:09:02:23 between the zero
and two years.
227 01:09:02:25 01:09:04:28 We thought these people
would come out of college
228 01:09:05:00 01:09:06:12 and know "I want
to be a teacher"
229 01:09:06:14 01:09:07:21 and go right into education.
230 01:09:07:23 01:09:09:02 But that wasn't the case.
231 01:09:09:04 01:09:11:08 I think one person had
five years' experience
232 01:09:11:10 01:09:13:24 in another field, and another
person had seven years
233 01:09:13:26 01:09:17:12 so we didn't find a very good
correlation between the two.
234 01:09:17:14 01:09:20:01 KADER:
Didn't you indicate
in your discussion
235 01:09:20:03 01:09:21:19 that there was another question
236 01:09:21:21 01:09:23:24 that... that you wish
you had addressed?
237 01:09:23:26 01:09:26:10 We thought maybe
the reason why
that is the case
238 01:09:26:12 01:09:28:01 is maybe when
these people graduated
239 01:09:28:03 01:09:30:04 there weren't many jobs
out there available.
240 01:09:30:06 01:09:32:07 So we thought maybe
if we knew people's ages
241 01:09:32:09 01:09:33:20 that would help a little bit
242 01:09:33:22 01:09:36:07 to help us understand
why that was the case.
243 01:09:36:09 01:09:37:20 KADER:
And that often happens
244 01:09:37:22 01:09:40:00 that you discover after
you've done your investigation
245 01:09:40:02 01:09:43:08 that "Gosh, I wish
I had asked this," so...
246 01:09:43:10 01:09:46:16 I think what we've just seen is
really the way statistics works.
247 01:09:46:18 01:09:48:16 To use statistics,
we have to have data;
248 01:09:48:18 01:09:50:21 to get data, we have
to ask a question
249 01:09:50:23 01:09:52:19 where we measure some variable.
250 01:09:52:21 01:09:56:28 In fact, I think of statistics
as having four ingredients.
251 01:09:57:00 01:09:59:24 I think of statistics

as a problem-solving process
252 01:09:59:26 01:10:03:17 and doing a statistical
investigation begins
253 01:10:03:19 01:10:08:11 by taking the problem and
asking a statistics question:
254 01:10:08:13 01:10:09:25 "How long have
you been teaching?"
255 01:10:09:27 01:10:11:25 "What was your major
in undergraduate school?"
256 01:10:11:27 01:10:14:09 "How many years have you
been out of education?"
257 01:10:14:11 01:10:15:27 Those sorts of questions, okay.
258 01:10:15:29 01:10:18:28 Once we decide what question
we want to ask in statistics
259 01:10:19:00 01:10:23:19 we collect appropriate data,
if that's at all possible.
260 01:10:23:21 01:10:26:10 We analyze the data,
we interpret the results.
261 01:10:26:12 01:10:29:10 One of the things I think
that was very interesting
262 01:10:29:12 01:10:30:19 that happened in this group
263 01:10:30:21 01:10:32:17 is this is not
a sequential process always.
264 01:10:32:19 01:10:34:01 A lot of times when we get here
265 01:10:34:03 01:10:35:19 we say, "Oh, I want
something else"
266 01:10:35:21 01:10:37:27 and we start the process
all over again.
267 01:10:37:29 01:10:39:16 It's a cyclical process.
268 01:10:39:18 01:10:41:23 It's not necessarily sequential.
269 01:10:41:25 01:10:44:02 You can move
from collecting data
270 01:10:44:04 01:10:47:02 back to asking
the question again.
271 01:10:47:04 01:10:48:22 Often those kinds
of things occur.
272 01:10:48:24 01:10:51:06 NARRATOR:
Next, Professor Kader
introduces an activity
273 01:10:51:08 01:10:53:09 where the teachers gain
additional experience
274 01:10:53:11 01:10:54:24 in collecting data.
275 01:10:54:26 01:10:57:05 KADER:
...because the data
is really the heart
276 01:10:57:07 01:10:58:20 of what goes on in statistics.
277 01:10:58:22 01:11:00:29 So to really kind of come
to an understanding
278 01:11:01:01 01:11:03:13 of the kinds of things
you do with that data
279 01:11:03:15 01:11:05:29 I think you need
to experience collecting it.
280 01:11:06:01 01:11:07:24 That makes sense,
that's good.
281 01:11:07:26 01:11:13:00 KADER:
Collecting data gives students a

sense of ownership of that data.

282 01:11:13:02 01:11:16:21 It makes the kinds of ways
you look at the data

283 01:11:16:23 01:11:19:10 and the analysis
more reasonable.

284 01:11:19:12 01:11:24:01 It gives you more insight,
I think, into the whole process.

285 01:11:24:03 01:11:26:18 Now, you're going to be working
in pairs and...

286 01:11:26:20 01:11:29:17 NARRATOR:
Professor Kader introduces
the first problem:

287 01:11:29:19 01:11:33:01 "How many inches wide
is the classroom?"

288 01:11:33:03 01:11:36:13 He then asks the teachers
to collect three measurements

289 01:11:36:15 01:11:41:01 using three different
measuring instruments:

290 01:11:41:03 01:11:43:23 a person's stride,
a 12-inch ruler

291 01:11:43:25 01:11:46:14 and a tape measure.

292 01:11:46:16 01:11:48:04 Ready?

293 01:11:48:06 01:11:49:20 (*teachers conversing*)

294 01:11:49:22 01:11:52:27 KADER:
The activity "Measuring
the Width of the Room"

295 01:11:52:29 01:11:56:26 is designed to have the teachers
think about how they get data

296 01:11:56:28 01:12:01:22 and to recognize that there are
different measuring instruments

297 01:12:01:24 01:12:05:20 that one might use in measuring
how wide the room is

298 01:12:05:22 01:12:08:21 and that each
measuring instrument

299 01:12:08:23 01:12:11:22 has its strengths
and weaknesses.

300 01:12:11:24 01:12:13:25 Nine strides

301 01:12:13:27 01:12:15:24 and my stride is
exactly 36 inches

302 01:12:15:26 01:12:18:19 so nine times 36 inches
and we have our total.

303 01:12:18:21 01:12:20:22 (*person coughing*)

304 01:12:20:24 01:12:22:15 Twenty.

305 01:12:22:17 01:12:26:27 KADER:
The goal of the activity is
to have the teachers thinking

306 01:12:26:29 01:12:29:06 about the fact that
there's variation in data

307 01:12:29:08 01:12:32:18 and that there are lots
of sources of variation in data.

308 01:12:32:20 01:12:33:24 Yeah.

309 01:12:33:26 01:12:36:00 But, you know,
that's not bad, 15.

310 01:12:36:02 01:12:37:02 (*laughs*)

311 01:12:37:04 01:12:37:22 Seventy-six.

312 01:12:37:24 01:12:38:15 Plus two more?

313 01:12:38:17 01:12:39:06 Plus...
314 01:12:39:08 01:12:40:00 Eleven and a...
315 01:12:40:02 01:12:41:00 Thirteen and a quarter.
316 01:12:41:02 01:12:43:03 And 289,
that's really off.
317 01:12:47:11 01:12:49:04 292½.
318 01:12:51:04 01:12:51:25 292½.
319 01:12:51:27 01:12:53:00 292½.
320 01:12:53:02 01:12:54:15 WOMAN:
So that's not as... as far.
321 01:12:54:17 01:12:55:22 MAN:
What did you get, Ellen?
322 01:12:55:24 01:12:58:10 292.
323 01:12:58:12 01:13:00:15 KADER:
If you wanted to know
how wide the room is
324 01:13:00:17 01:13:03:04 you might say, "Well, I think
a pace is about a yard for me.
325 01:13:03:06 01:13:04:09 "I'll step it off in yards
326 01:13:04:11 01:13:06:02 and I can get...
I can get an estimate"--
327 01:13:06:04 01:13:07:19 not necessarily a very good one.
328 01:13:07:21 01:13:10:09 And on the other hand, if I do
happen to have a tape measure
329 01:13:10:11 01:13:12:29 then I can get
a pretty good indication
330 01:13:13:01 01:13:14:18 of how wide the room is.
331 01:13:14:20 01:13:16:09 KADER:
What do you think?
332 01:13:16:11 01:13:19:26 NARRATOR:
The class returns to its seats
to compare results
333 01:13:19:28 01:13:21:13 and notices that group six
334 01:13:21:15 01:13:24:06 is the most consistent
in its data collection.
335 01:13:24:08 01:13:25:23 KADER:
Ahh, their three numbers
336 01:13:25:25 01:13:28:01 are pretty close to each other,
aren't they?
337 01:13:28:03 01:13:31:03 By the criteria
that we've just looked at
338 01:13:31:05 01:13:34:15 all being very consistent,
not to pick on anyone
339 01:13:34:17 01:13:37:17 but which pair was
least consistent?
340 01:13:37:19 01:13:38:27 MAN:
Okay, we'll admit it, okay?
341 01:13:38:29 01:13:41:25 (*laughter*)
342 01:13:41:27 01:13:45:05 Okay, which group is this?
343 01:13:45:07 01:13:46:23 Number eight,
and we're proud of it.
344 01:13:46:25 01:13:49:04 KADER:
Now, why is it that
you say that, group eight?
345 01:13:49:06 01:13:50:09 MAN:
That we're proud of it?

346 01:13:50:11 01:13:51:25 It's called
a defense mechanism.
347 01:13:51:27 01:13:53:20 KADER:
Let's see,
you have a minimum of what?
348 01:13:53:22 01:13:55:06 MAN:
We had 230 on the first.
349 01:13:55:08 01:13:56:12 KADER:
230 to 292.
350 01:13:56:14 01:13:58:16 But wait a minute,
wait a minute.
351 01:13:58:18 01:14:01:07 Look at number four.
352 01:14:01:09 01:14:05:20 378 to 293.
353 01:14:05:22 01:14:07:20 Um, I'm not sure
I want any of you folks
354 01:14:07:22 01:14:10:19 building my house any time soon.
355 01:14:10:21 01:14:13:10 Which of these procedures
is the best in your opinion?
356 01:14:13:12 01:14:14:18 WOMAN:
The tape measure.
357 01:14:14:20 01:14:17:00 KADER:
The tape measure, exactly.
358 01:14:17:02 01:14:19:23 What's going on
with the other procedures?
359 01:14:19:25 01:14:22:16 WOMAN:
Number one doesn't have
the clear instruction
360 01:14:22:18 01:14:24:28 as to where you should
start measuring from
361 01:14:25:00 01:14:27:13 when you do the strides.
362 01:14:27:15 01:14:28:26 KADER:
When you do the strides?
363 01:14:28:28 01:14:31:20 Well, from wall to wall,
but what's the difficulty there?
364 01:14:31:22 01:14:33:17 WOMAN:
And when you
start walking, you know
365 01:14:33:19 01:14:34:29 you may actually change that--
366 01:14:35:01 01:14:36:23 that may vary quite a bit.
367 01:14:36:25 01:14:37:29 KADER:
So certainly
368 01:14:38:01 01:14:39:15 that would be
the worst one, okay.
369 01:14:39:17 01:14:40:19 Does it look the worst?
370 01:14:40:21 01:14:42:14 The ruler isn't good either
371 01:14:42:16 01:14:46:12 because the ruler is only 12
inches, and 12 inches is...
372 01:14:46:14 01:14:49:03 There's a lot of variance, so
you have to put ruler end to end
373 01:14:49:05 01:14:50:24 so you're using your finger
or something
374 01:14:50:26 01:14:53:08 and then that might be a couple
of inches here and there
375 01:14:53:10 01:14:55:10 and then you may not
get the line straight
376 01:14:55:12 01:14:57:01 because it can be

broken, you know
377 01:14:57:03 01:14:58:13 you have to be
really careful
378 01:14:58:15 01:14:59:26 to get it
actually straight.
379 01:14:59:28 01:15:01:13 KADER:
And it does look
380 01:15:01:15 01:15:04:21 like using the tape measure,
we did pretty well.
381 01:15:04:23 01:15:07:01 Let's see,
we went from 292 to 293
382 01:15:07:03 01:15:09:00 so we only differ by an inch.
383 01:15:09:02 01:15:10:17 But we still have what?
384 01:15:10:19 01:15:11:22 Do we all agree?
385 01:15:11:24 01:15:13:06 Okay, so what's the word
you said?
386 01:15:13:08 01:15:14:06 Variation.
387 01:15:14:08 01:15:15:09 KADER:
Variation.
388 01:15:15:11 01:15:16:27 Yes, Larry.
389 01:15:16:29 01:15:19:11 LARRY:
We made an assumption
that the room was square
390 01:15:19:13 01:15:21:20 and not all of us measured
in the same place
391 01:15:21:22 01:15:23:16 so, in fact,
in defense of our 292
392 01:15:23:18 01:15:26:25 it might have been 292
where we measured.
393 01:15:26:27 01:15:28:29 Most likely not,
but theoretically
394 01:15:29:01 01:15:31:27 we made an assumption
that the room was square.
395 01:15:31:29 01:15:33:19 Ideally, we would all measure
396 01:15:33:21 01:15:35:00 the same section of the room
397 01:15:35:02 01:15:36:15 and even then we may not end up
398 01:15:36:17 01:15:38:13 at exactly the same spot,
but hopefully
399 01:15:38:15 01:15:41:09 there wouldn't be that much
variation in our answers.
400 01:15:41:11 01:15:43:02 So that's exactly right.
401 01:15:43:04 01:15:46:17 So, what's the lesson?
402 01:15:46:19 01:15:48:05 Why did I do this?
403 01:15:48:07 01:15:51:13 You're showing that depending
on the tools you use
404 01:15:51:15 01:15:52:19 that there are
some tools
405 01:15:52:21 01:15:54:14 that are much more
accurate than others;
406 01:15:54:16 01:15:56:26 obviously the stride is
the least accurate of them.
407 01:15:56:28 01:15:58:10 That's exactly right.
408 01:15:58:12 01:15:59:23 And the larger tool
409 01:15:59:25 01:16:01:12 that you use to have...
to measure
410 01:16:01:14 01:16:03:07 is going to be

			your more accurate one.
411	01:16:03:09	01:16:04:23	KADER: Exactly, but even when using
412	01:16:04:25	01:16:06:28	a more accurate tool, sometimes we still have what?
413	01:16:07:00	01:16:08:16	CLASS: Variation.
414	01:16:08:18	01:16:10:27	Variation, and that variation here is due
415	01:16:10:29	01:16:13:27	to measurement error, okay, for the most part, okay?
416	01:16:13:29	01:16:15:28	It may be due to the lack of the room being square.
417	01:16:16:00	01:16:19:00	But... So part of what you have to deal with
418	01:16:19:02	01:16:21:09	when you collect data in statistics
419	01:16:21:11	01:16:23:29	is variation, and there are all kinds of things
420	01:16:24:01	01:16:25:02	that can contribute
421	01:16:25:04	01:16:27:12	to that variation, okay?
422	01:16:27:14	01:16:29:04	One of them is measurement error.
423	01:16:29:06	01:16:31:25	NARRATOR: Before ending the session, Professor Kader
424	01:16:31:27	01:16:35:11	introduces an activity that focuses on the bias
425	01:16:35:13	01:16:37:15	that sometimes occurs in statistical results.
426	01:16:37:17	01:16:40:15	KADER: Collecting data is a lot of what you do in statistics
427	01:16:40:17	01:16:43:09	and one way we collect data is to take surveys.
428	01:16:43:11	01:16:45:04	I'd like to take a survey
429	01:16:45:06	01:16:48:19	of this group's opinion regarding nuclear power.
430	01:16:51:11	01:16:54:00	KADER: The purpose of the nuclear power survey
431	01:16:54:02	01:16:58:00	was to lead people that you survey to a certain conclusion.
432	01:16:59:17	01:17:02:06	It's called "bias" in your survey.
433	01:17:03:26	01:17:05:10	KADER: I gave some of you
434	01:17:05:12	01:17:07:26	this survey, in which four questions were asked.
435	01:17:27:20	01:17:30:15	Now, not all of you got that questionnaire, did you?
436	01:17:30:17	01:17:33:06	Some of you got this questionnaire.
437	01:17:55:16	01:18:00:10	Now, would you agree, if you said yes to this question
438	01:18:00:12	01:18:03:11	you would more than likely say

what to this question?

439 01:18:03:13 01:18:04:11 WOMAN:
No.

440 01:18:04:13 01:18:06:22 No.

441 01:18:06:24 01:18:08:23 Well, let's see what happened.

442 01:18:08:25 01:18:13:04 Here are the results from
this question that A dealt with:

443 01:18:13:06 01:18:17:16 "Should we reduce the number
of nuclear power stations?"

444 01:18:17:18 01:18:20:23 More than half of the people
said yes, we should.

445 01:18:20:25 01:18:22:07 In survey B, the last question

446 01:18:22:09 01:18:26:13 "Should we maintain our
nuclear energy power stations?"

447 01:18:26:15 01:18:28:20 almost everyone said what?

448 01:18:28:22 01:18:29:20 CLASS:
Yes.

449 01:18:29:22 01:18:31:07 Yes.

450 01:18:31:09 01:18:33:18 What's going on?

451 01:18:33:20 01:18:34:24 You were biasing the survey.

452 01:18:34:26 01:18:35:28 KADER:
That's exactly right.

453 01:18:36:00 01:18:37:17 Some people know

454 01:18:37:19 01:18:41:15 what it is they want
the world to think

455 01:18:41:17 01:18:43:14 and so they go out
and design a survey

456 01:18:43:16 01:18:45:03 to get them to think that way

457 01:18:45:05 01:18:49:02 which is exactly what
these two surveys demonstrate.

458 01:18:49:04 01:18:51:25 In fact, I did this survey
with a group of students

459 01:18:51:27 01:18:53:08 not too long ago

460 01:18:53:10 01:18:57:09 and there are the results
I got from that group.

461 01:18:57:11 01:18:58:22 16 yes, 17 yes.

462 01:18:58:24 01:19:03:13 Again, predominately "yes"
in both case... cases.

463 01:19:03:15 01:19:05:29 And that's what each survey
is leading you to say:

464 01:19:06:01 01:19:08:22 "Yes, yes, yes, yes, I agree
with all of these things"

465 01:19:08:24 01:19:11:03 and you sort of get
in the flow of saying yes.

466 01:19:11:05 01:19:13:11 Some of you didn't;
some of you were clever

467 01:19:13:13 01:19:14:26 and saw what I was trying to do.

468 01:19:14:28 01:19:17:02 But if we put
the two groups together

469 01:19:17:04 01:19:18:16 it's even more apparent.

470 01:19:18:18 01:19:21:08 Again, you would expect
people who say yes here

471 01:19:21:10 01:19:24:00 would probably say no here,
and I don't know--

472 01:19:24:02 01:19:26:14 I mean, I didn't really bias
how I gave the survey out--

473	01:19:26:16	01:19:29:16	I just sort of gave A, A, B, B, and so on and so forth.
474	01:19:29:18	01:19:30:24	I'm curious--
475	01:19:30:26	01:19:32:14	you're acknowledging a bias in the survey
476	01:19:32:16	01:19:34:10	and I'm wondering where you identify that bias.
477	01:19:34:12	01:19:35:17	Where I identify it?
478	01:19:35:19	01:19:38:05	Are you saying that because the first three
479	01:19:38:07	01:19:39:25	were answered in a particular way
480	01:19:39:27	01:19:42:11	it led you to answer the fourth in a particular...
481	01:19:42:13	01:19:43:18	or was it in fact
482	01:19:43:20	01:19:45:29	the phrasing of that final question?
483	01:19:46:01	01:19:49:21	Because when I saw it, not knowing the other survey
484	01:19:49:23	01:19:51:20	I answered one way but I wanted to qualify it.
485	01:19:51:22	01:19:52:29	I mean, I wrote, "Yes, but..."
486	01:19:53:01	01:19:54:00	I saw your "but."
487	01:19:54:02	01:19:55:22	And I felt the way
488	01:19:55:24	01:19:58:02	that it was expressed, the last question itself
489	01:19:58:04	01:20:00:24	you didn't even have to have questions one through three
490	01:20:00:26	01:20:01:26	biased to the survey.
491	01:20:01:28	01:20:03:16	Oh... okay.
492	01:20:03:18	01:20:07:20	Well, my intent was to have the preceding three questions
493	01:20:07:22	01:20:10:04	lead you into that fourth question.
494	01:20:10:06	01:20:11:22	That was my intent
495	01:20:11:24	01:20:13:21	so you jumped right into question four
496	01:20:13:23	01:20:16:00	sort of knowing where the survey was going.
497	01:20:16:02	01:20:17:22	I wonder, it would be interesting to see
498	01:20:17:24	01:20:19:09	if you kept the first three the same
499	01:20:19:11	01:20:21:06	but essentially had the fourth statement
500	01:20:21:08	01:20:22:28	the exact, or maybe just the opposite
501	01:20:23:00	01:20:24:13	so either the answer's yes or no
502	01:20:24:15	01:20:25:20	the wording the same.
503	01:20:25:22	01:20:27:19	I'd be curious in seeing

how that worked out.

504 01:20:27:21 01:20:29:04 KADER:
I agree.

505 01:20:29:06 01:20:31:03 If you sequence the questions
in the right way

506 01:20:31:05 01:20:32:12 you can get people to say

507 01:20:32:14 01:20:34:06 just about anything
you want them to say.

508 01:20:34:08 01:20:35:06 Yes, Sue?

509 01:20:35:08 01:20:37:02 But if you have a belief

510 01:20:37:04 01:20:38:21 before you read that

511 01:20:38:23 01:20:41:16 is that mostly for people
that really are on the fence

512 01:20:41:18 01:20:42:28 and don't really have

513 01:20:43:00 01:20:44:26 an understanding
of the situation?

514 01:20:44:28 01:20:47:16 I agree that for some people,
that's not going to sway them

515 01:20:47:18 01:20:49:27 but people who are fence-
sitters, "Oh, yes, yes, yes

516 01:20:49:29 01:20:52:10 sure, sure, I agree with this,"
and yes to the last one

517 01:20:52:12 01:20:54:09 so you're just
sort of rolling along there

518 01:20:54:11 01:20:55:29 and that's how, often

519 01:20:56:01 01:20:59:03 bias is entered into data
that we collect in statistics.

520 01:20:59:05 01:21:01:03 WOMAN:
I was also going to say

521 01:21:01:05 01:21:02:28 that by the way
you word the question

522 01:21:03:00 01:21:04:11 you narrow the choices.

523 01:21:04:13 01:21:07:16 So when you were saying,
"Yes, but..."

524 01:21:07:18 01:21:09:16 there's no room
for "but."

525 01:21:09:18 01:21:11:02 You eliminate
certain responses

526 01:21:11:04 01:21:12:25 which is what
you might want to do

527 01:21:12:27 01:21:14:29 if you are biasing
your survey.

528 01:21:15:01 01:21:16:24 Of course,
the other side of the coin

529 01:21:16:26 01:21:18:21 is that it's difficult
to analyze data

530 01:21:18:23 01:21:20:10 where you give lots of options.

531 01:21:20:12 01:21:22:14 You can't incorporate
every possible option

532 01:21:22:16 01:21:25:00 into what you list there.

533 01:21:25:02 01:21:26:16 Unless you break it down.

534 01:21:26:18 01:21:27:21 WOMAN:
My question is

535 01:21:27:23 01:21:29:22 is there any such thing
as a fair survey?

536 01:21:29:24 01:21:31:00 I think

they exist, yeah.

537 01:21:31:02 01:21:32:20 There's a lot
of research on that

538 01:21:32:22 01:21:36:21 going about asking questions in
the right way to not show bias

539 01:21:36:23 01:21:38:25 and on the other side
of the coin

540 01:21:38:27 01:21:41:03 there's probably just as much
into phrasing questions

541 01:21:41:05 01:21:43:22 to do just what
we just demonstrated.

542 01:21:43:24 01:21:49:06 Okay, I want to summarize
by saying the model introduced

543 01:21:49:08 01:21:51:26 at the end of the first half
of the session is something

544 01:21:51:28 01:21:54:10 that's going to be with us
for the next eight days

545 01:21:54:12 01:21:59:09 and that is,
when you're doing statistics

546 01:21:59:11 01:22:01:27 you're really doing four things:

547 01:22:01:29 01:22:05:00 you're asking
statistics questions;

548 01:22:05:02 01:22:10:00 you're collecting data;
you're analyzing that data;

549 01:22:10:02 01:22:12:00 and you interpret the results

550 01:22:12:02 01:22:15:15 in an attempt to provide some
sort of answer to this question.

551 01:22:15:17 01:22:17:05 WOMAN:
I thought
that most of the people

552 01:22:17:07 01:22:19:06 that fell
in the education...

553 01:22:19:08 01:22:20:16 WOMAN:
I'm learning

554 01:22:20:18 01:22:22:25 that you're not done
when you finish the graph.

555 01:22:22:27 01:22:25:23 You should try to answer the
question that you first posed.

556 01:22:25:25 01:22:27:14 So I'm learning more process--

557 01:22:27:16 01:22:29:29 not so much the final product
of the graph

558 01:22:30:01 01:22:32:22 but what's involved in it,
and then afterwards looking back

559 01:22:32:24 01:22:34:22 and reflecting and analyzing
what you've done.

560 01:22:34:24 01:22:36:17 We're also trying to...

561 01:22:36:19 01:22:39:24 SUE:
I feel like I've gained a lot
from this statistics class

562 01:22:39:26 01:22:42:27 as far as
my understanding of it.

563 01:22:42:29 01:22:46:23 I used to teach
the skills of statistics

564 01:22:46:25 01:22:48:13 but they were in isolation

565 01:22:48:15 01:22:50:16 and now I know
that they're all connected

566 01:22:50:18 01:22:53:16 and how to move fluidly
through them.
567 01:22:56:06 01:22:58:15 (*hammers pounding,*
power saw whining)
568 01:23:02:27 01:23:04:06 MAN:
A few years ago
569 01:23:04:08 01:23:06:25 I wrote a book called
Measure Twice, Cut Once
570 01:23:06:27 01:23:11:02 and it's about using the tools
in the carpenter's toolbox
571 01:23:11:04 01:23:14:06 but it also spends some time
talking about measuring.
572 01:23:14:08 01:23:16:28 Every time you measure
something with a tool
573 01:23:17:00 01:23:19:06 you're subject to inaccuracies
574 01:23:19:08 01:23:21:09 either because
of the tool itself
575 01:23:21:11 01:23:23:17 or because of how you read it
576 01:23:23:19 01:23:25:26 or how someone is transferring
a measurement to you.
577 01:23:25:28 01:23:27:22 All of those things build error
578 01:23:27:24 01:23:30:14 into the measurement
that you're trying to get.
579 01:23:30:16 01:23:33:09 (*saw whining*)
580 01:23:33:11 01:23:35:19 As carpenters we often
work in teams or pairs
581 01:23:35:21 01:23:38:12 and you're transferring
measurements to one another
582 01:23:38:14 01:23:41:15 and you can get a lot of error
583 01:23:41:17 01:23:43:23 because you're not
using the same measuring tool.
584 01:23:43:25 01:23:45:24 And we can sort
of demonstrate
that for you.
585 01:23:45:26 01:23:47:15 Here we have
a folding wood rule.
586 01:23:47:17 01:23:48:27 Tom has a folding
wood rule
587 01:23:48:29 01:23:50:01 and let's see
how close
588 01:23:50:03 01:23:51:23 they actually are
to one another.
589 01:23:51:25 01:23:52:24 If we butt
them up
590 01:23:52:26 01:23:54:18 against the same
spot on the wall
591 01:23:54:20 01:23:58:10 you can clearly see
that my rule is longer
592 01:23:58:12 01:24:01:22 by almost a sixteenth
of an inch here at 39.
593 01:24:01:24 01:24:04:01 So, the tools really
do make a difference
594 01:24:04:03 01:24:06:27 and every tape will vary one
to the other by varying degrees.
595 01:24:06:29 01:24:08:15 TOM:
But as partners,

you get together
596 01:24:08:17 01:24:11:28 and he would eventually
know that my tape
597 01:24:12:00 01:24:13:25 or my ruler may be
598 01:24:13:27 01:24:15:16 a sixteenth-of-an-inch
difference.
599 01:24:15:18 01:24:17:22 So he would then
compensate for that.
600 01:24:17:24 01:24:19:17 Measuring is somewhat
of a judgment call;
601 01:24:19:19 01:24:22:09 it's all how you read the tape.
602 01:24:22:11 01:24:25:07 For instance, if we're measuring
between this window opening
603 01:24:25:09 01:24:28:24 if I'm standing over here,
I'm saying
604 01:24:28:26 01:24:31:03 that that's reading like 39½.
605 01:24:31:05 01:24:38:07 If I'm standing way over here,
I'm reading, oh, about 39 3/8.
606 01:24:38:09 01:24:40:00 To get the
most accurate measurement
607 01:24:40:02 01:24:42:14 I want to be right dead on
looking straight at it
608 01:24:42:16 01:24:44:17 in which case
it's between those two
609 01:24:44:19 01:24:48:03 which is 39 7/16, so that's
my most accurate measurement.
610 01:24:48:05 01:24:51:10 Another way that we measure
as builders and carpenters
611 01:24:51:12 01:24:54:28 is actually not to use a tool
at all, but to actually bring
612 01:24:55:00 01:24:57:22 the piece of wood
that we're trying to install.
613 01:24:57:24 01:25:01:02 For instance, if I was trying
to install a piece of wood
614 01:25:01:04 01:25:04:12 between these two walls,
I would bring the piece of wood
615 01:25:04:14 01:25:06:14 put it up
against one side of the wall
616 01:25:06:16 01:25:07:25 and mark the other side.
617 01:25:07:27 01:25:09:13 That way
there's very little error
618 01:25:09:15 01:25:12:04 because the piece that's going
to go there is being marked
619 01:25:12:06 01:25:14:18 rather than taking a measurement
and transferring it.
620 01:25:14:20 01:25:16:27 Every time
you move a measurement
621 01:25:16:29 01:25:19:19 you take the chance
of having an error.
622 01:25:19:21 01:25:21:19 (*saw whining*)
623 01:25:25:17 01:25:27:12 Now, we are subject
to measuring with tools
624 01:25:27:14 01:25:29:01 and that's really where
625 01:25:29:03 01:25:32:04 "measure twice, cut once"
comes in, is that...
626 01:25:32:06 01:25:35:05 compensate for

those inaccuracies

627 01:25:35:07 01:25:37:22 take the most accurate measurement that you can take

628 01:25:37:24 01:25:40:13 so that when you lay out the piece of wood

629 01:25:40:15 01:25:43:04 that you're going to use and make that cut

630 01:25:43:06 01:25:44:14 it's going to fit.

631 01:25:46:15 01:25:49:13 [Captioned by
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